UNIVERSITY OF Southampton

Programme Specification

MSc Micro and Nanotechnology (2018-19)

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of study	Full Time
Duration in years	1 Year
Accreditation details	IET accreditation sought
Final award	Master of Science (MSc)
Name of award	Micro and Nanotechnology
Interim Exit awards	Postgraduate Diploma (PgDip) Postgraduate Certificate (PgCert)
FHEQ level of final award	Level 7
UCAS code	N/A
QAA Subject Benchmark or other external reference	The UK Quality Assurance Agency's Framework for Higher Education Qualifications (FHEQ) and Subject Benchmark Statement (Engineering Masters) The IET Learning Outcomes Handbook The Engineering Council UK-SPEC
Programme Lead	Maurits de Planque
Date specification was written	20/02/2017
Date Programme was validated	13/06/2017
Date specification last updated	20/07/2017

Programme Overview

Brief outline of the programme

This programme outlines the micro and nanotechnology aspects of electronic engineering, with a focus on microelectromechanical systems and nanoelectronics. These technologies, for example, underpin research and development of miniaturised sensors, including the motion and position sensors in mobile phones, and of nanoscale logic and memory devices for next-generation consumer electronics and future quantum devices. The programme also addresses microfluidic technology, enabling miniaturised biodevices for point-of-care diagnostic applications, and covers the fundamentals of photonic circuits and devices.

The modules which comprise this masters degree involve state-of-the-art design, fabrication and characterisation methodologies, utilising industry-standard tools and our state-of-the-art cleanroom complex. In the taught element of the programme you can select half of your modules to suit your interest. You will also have the opportunity to prepare yourself for your individual research project with a dedicated project preparation module. The contact hours and the extent of group work will vary depending on your module choices; full information is provided in individual module profiles.

Special features of the programme
Southampton is recognised to be internationally leading in the areas mentioned above, and specialist modules are taught by staff involved in leading edge research. Students are therefore exposed to the most up to date thinking, current research problems, and state of the art techniques, technologies and tools.

Learning and teaching
The range of teaching and learning methods is explained in the following sections covering programme learning outcomes.

Assessment
The range of assessment methods used to enable students to demonstrate the achievement of intended learning outcomes is explained in the following sections.

Please note: As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a

student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our Disclaimer to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's programme validation process which is described in the University's Quality handbook.

Educational Aims of the Programme

The aims of the programme are to enable you to:

1) Develop original ideas and solve complex problems in new or unfamiliar environments, based on advanced knowledge of the principles and methodologies of the microtechnology and nanotechnology aspects of electronic engineering
2) Integrate knowledge and handle complexity in this area of electronic engineering, formulating sound judgements with incomplete or limited data
3) Communicate your conclusions and the underpinning knowledge and rationale clearly and unambiguously to specialist and non-specialist audiences
4) Develop your independent learning skills as required for continued professional development

Programme Learning Outcomes

Knowledge and Understanding

Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

A1 The scientific and engineering principles underpinning a range of micro and nanoscale technologies and the application of electronic engineering to micro and nanoscale devices
A2 Techniques used for the fabrication of micro and nanoscale electronic devices
A3 Methods for the characterisation and analysis of micro and nanoscale electronic systems and devices
A4 The design and simulation of micro and nanoscale electronic systems and devices
A5 A range of applications of micro and nano technologies, including sensors

Teaching and learning methods
A1-A5: Most modules consist of a combination of lectures, small group teaching, practical work, directed reading and coursework assignments. At the end of the taught part of the programme you will undertake an individual project associated with a research group. Small group teaching, including all practical work, and the individual project accommodate different learning styles. One-on-one tutorials can support full-class lectures, when required.

Assessment methods
Testing of the knowledge base is through a combination of unseen written examinations and assessed coursework in the form of problem solving exercises, laboratory reports with literature review components, design exercises, and individual and small-group projects.

Subject Specific Intellectual and Research Skills

Having successfully completed this programme you will be able to:

B1 Specify, design and realise electronic micro and nano devices with attention to a wide range of outcomes, including technical, practical, innovation and sustainability
B2 Use mathematical methods to model and simulate the behaviour of micro and nanoscale electronic systems, in part or entirely, at the appropriate level of detail
B3 Verify the functionality of a micro or nanoscale device design with an appropriate characterisation methodology
B4 Find, select, summarise and explain literature related to micro and nanoscale electronic engineering technologies, including scientific publications, industrial documentation, standards, ethical, legal and environmental guidance
B5 Plan and manage a research project involving an advanced and specialised micro/nanoscale system/device/methodology, using appropriate state of the art techniques/technologies/tools, to obtain, analyse and discuss scientific data

Teaching and learning methods

B1-B4: Most modules consist of a combination of lectures, small group teaching, and practical work including advanced design and analysis tools, directed reading and coursework assignments, which can include a literature review. B4, B5: The Project Preparation module and the Individual Project itself concern the formulation of a research project. Small group teaching, including all practical work, and the individual project accommodate different learning styles. One-on-one tutorials can support full-class lectures, when required.

Assessment methods
B1-B5: Testing of the subject specific intellectual and research skills is through a combination of unseen written examinations and assessed coursework in the form of problem solving exercises, laboratory reports with literature review components, design exercises, and individual and small-group projects.
B4: The Project Preparation module and the dissertation from the MSc Project include a significant literature survey and peer review, and have assessment criteria related specifically to these skills.
B5: The Project dissertation is centrally focussed on assessing research and development skills.

Transferable and Generic Skills

Having successfully completed this programme you will be able to:

- C1 Use conventional and electronic indexing and search methods to find technical information
- C2 Present technical information concisely in written and verbal forms to a range of audiences
- C3 Work in a pair or in a small group, managing your own contribution and the overall task
- C4 Work independently on a significant research project, managing time and risk in an effective manner
- C5 Recognise legal and ethical issues of concern to business, professional bodies and society, and follow relevant guidelines to address these issues

Teaching and learning methods
A number of modules have a significant coursework element. This can range from design work through to presentations resulting from directed reading. The individual project includes independent research, project management and report writing.
C1-C3: Most modules include small group teaching, practical work with one or more lab partners, directed reading and coursework assignments with a literature review component. The Project Preparation module includes project management and the delivery of a project plan via a presentation. Small group teaching, including all practical work, and the individual project accommodate different learning styles.
C4: The individual project includes independent research and report writing.
C5: Legal, ethical and professional issues are covered in the Project Preparation module.

Assessment methods
Coursework is generally assessed through written reports. The individual project is assessed by a dissertation of up to 15,000 words. The Project Preparation module is assessed via a literature review, as well as written and presentation versions of the project plan.

Subject Specific Practical Skills (optional)

Having successfully completed this programme you will be able to:

- D1 Use specialist tools for the design, realisation and analysis of micro and nanoscale electronic systems and devices

Teaching and learning methods
D1: Most modules include practical work, involving use of industry-standard specialised tools for the design, realisation and analysis of micro and nanoscale electronic systems and devices. These specialised tools are taught within the modules.

Assessment methods
Assessment is based on coursework in the form of technical reports, device designs and realisation, software designs and implementation, and also the MSc dissertation.

Disciplinary Specific Learning Outcomes (optional)

n/a

Programme Structure

Typical course content

This programme consists of eight taught modules, each worth 7.5 ECTS credits and an individual research project worth 30 ECTS credits. In the compulsory semester 2 module Project Preparation you will undertake appropriate preparatory study for this research project, and you will also examine ethical and legal issues around professional practice. You can choose four modules (two options in semester 1 and two options in semester 2) from a range of topics covering advanced and specialised aspects of microtechnology and nanotechnology, allowing you to tailor the structure to suit your own interests.

Programme details

There are a number of compulsory and optional taught modules. Most options are at level 7 (masters). However, two options are at level 6: ELEC3202 and ELEC3207. Should more level-6 options be added to the programme, at most two level-6 options may be taken, thereby giving a maximum of 15 ECTS credits below the level of the award. As there are a several options, students will be given generic and individual advice to help them make an appropriate selection, based on their background and interests. It is possible to concentrate on specific technologies: MicroElectroMechanical Systems, Nanoelectronics, Biodevices, or Optoelectronics, but this is not required. It should be noted that it may not be possible to run some optional modules if the number of students registered on the module is very small.

In semester 1, ELEC6201 and ELEC6203 are compulsory. In semester 2, ELEC6208 and ELEC6211 are compulsory. Semester 1 modules can have co-requisites and semester 2 modules can have pre-requisites.

The following is the normal pattern of study for a full-time student, completing the programme within 12 calendar months:

Semester 1: Four modules, including ELEC6201 and ELEC6203. Examinations are held in January.

Semester 2: Four modules, including ELEC6208 and ELEC6211. Examinations are held in May/June.

Summer: You will undertake an individual research project lasting up to 14 weeks, which is assessed by a 15,000-word dissertation.

The programme structure is shown in the following tables:

Semester 1 (total of 30 ECTS credits)

Type	Code	Title	Level	ECTS
compulsory	ELEC6201	Microfabrication	7	7.5
compulsory	ELEC6203	Microsensor Technologies	7	7.5
optional	ELEC3207	Nanoelectronic Devices	6	7.5
optional	ELEC6202	Advanced Memory and Storage	7	7.5
optional	ELEC6204	Microfluidics and Lab-on-a-Chip	7	7.5
optional	ELEC6205	Bionanotechnology	7	7.5
optional	OPTO6007	Introduction to Silicon Photonics	7	7.5

The interim exit award after semester 1 can be a Postgraduate Certficate.

Semester 2 (total of 30 ECTS credits)

Type	Code	Title	Level	ECTS
compulsory	ELEC6208	Bio/Micro/Nano Systems	7	7.5
compulsory	ELEC6211	Project Preparation	7	7.5
optional	ELEC3202	Green Electronics	6	7.5
optional	ELEC6206	Nanofabrication and Microscopy	7	7.5
optional	ELEC6207	Quantum Devices and Technology	7	7.5
optional	ELEC6227	Medical and Electrical Technologies	7	7.5
optional	OPTO6003	Photonic Materials	7	7.5

The interim exit award after semester 2 can be a Postgraduate Certficate or a Postgraduate Diploma.

Summer (total of 30 ECTS credits)

Type	Code	Title	Level	ECTS
core	COMP6200	MSc Project	7	30

Additional costs

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. Costs that students registered for this programme typically also have to pay for are included in Appendix 2.

Progression requirements

The programme follows the University's regulations for ***Progression, Determination and Classification of Results : Standalone Masters Programmes*** as set out in the University Calendar.

Intermediate exit points

You will be eligible for an interim exit award if you complete part of the programme but not all of it, as follows:

Qualification	Minimum overall credit in ECTS	Minimum ECTS required at level of award
Postgraduate Diploma	at least 60	45
Postgraduate Certificate	at least 30	20

Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area.

The University provides:

- Library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources
- High speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices – laptops, smartphones and tablet PCs – via the Eduroam wireless network; there is a wide range of application software available from the Student Public Workstations
- Computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- Standard ICT tools such as Email, secure filestore and calendars
- Access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Hartley Library
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling
- Assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia)
- The Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards
- Career Destinations, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV

- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls (18.00-08.00)
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers

The Students' Union provides:

- An academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University
- Opportunities for extracurricular activities and volunteering
- An Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline

Associated with your programme you will be able to access:

- The tutorial system – you will have a personal tutor whom you can meet on request for advice on your programme and choice of options, or for pastoral support
- The mentor system – you will have a personal mentor whom you can meet regularly for study advice, or for pastoral support
- The ECS Student Advisory Team provides additional pastoral support
- ECS computer workstations, with a range of manuals and books
- Specialist project laboratories
- Post-graduate demonstrators who provide additional support for your practical projects
- Personal email account and web access, including use of on-line collaboration tools
- Helpdesk in ECS (programming advisory)
- A web-site for each taught module, typically with teaching materials

Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

- Completing student evaluation questionnaires for each module of the programme
- Acting as a student representative on various committees, e.g. Staff Student Liaison Committees, Faculty Programmes Committee OR providing comments to your student representative to feed back on your behalf
- Serving as a student representative on Faculty Scrutiny Groups for programme validation
- Taking part in programme validation meetings by joining a panel of students to meet with the Faculty Scrutiny Group

The ways in which the quality of your programme is checked, both inside and outside the University, are:

- Regular module and programme reports which are monitored by the Faculty
- Programme validation, normally every five years
- External examiners, who produce an annual report
- Professional body accreditation/inspection
- A national Research Excellence Framework (our research activity contributes directly to the quality of your learning experience)
- Higher Education Review by the Quality Assurance Agency for Higher Education

Criteria for admission

The University's Admissions Policy applies equally to all programmes of study. The following are the typical entry criteria to be used for selecting candidates for admission. The University's approved equivalencies for the requirements listed below will also be acceptable.

Undergraduate programmes

Qualification	Grades	Subjects required	Subjects not accepted	EPQ Alternative offer (if applicable)	Contextual Alternative offer (if applicable)
GCE A level	n/a	n/a	n/a	n/a	n/a
GCSE	n/a	n/a	n/a	n/a	n/a

Postgraduate programmes

Qualification	Grade/GPA	Subject requirements	Specific requirements
Bachelor's degree	2.1 Honours	a degree in electronic engineering or in a closely related discipline	- range of electronic engineering modules such as semiconductor devices, electronic circuit design, control and communications - physics and mathematics
Master's degree			

Mature applicants
Applications from mature students (over 21 years in the October of the year of entry) are welcome. Applications will be considered on an individual basis.

Recognition of Prior Learning (RPL)
The University has a **Recognition of Prior Learning Policy**

English Language Proficiency
If English is not your first language, you will be required to pass an approved English language test. We ask for the following minimal IELTS scores:

Overall	Reading	Writing	Speaking	Listening
6.5	6.0	6.0	6.0	6.0

Career Opportunities

This programme provides an excellent platform for a career in industry or in academia. Examples of industrial sectors are the electronics/semiconductor, telecommunications, photonics, materials and packaging, biotechnology, and car and aerospace industries. Graduates from our MSc programmes are employed worldwide in leading companies at the forefront of technology. As well as for larger multinationals, many students also go on to work for small to medium enterprises, including start-ups. ECS runs a dedicated careers hub which is affiliated with over 100 companies like IBM, ARM, Microsoft Research, Imagination Technologies, Nvidia, Samsung and Google to name a few. Visit our careers hub for more information.

External Examiner(s) for the Programme

Name to be decided
Institution ----------

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their personal tutor in the first instance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. More detailed information can be found in the FPSE Student Handbook.

Appendix 1:

Learning outcomes and Assessment Mapping document template

Learning Outcomes		Knowledge & Understanding					Intellectual & Research Skills					Transferable and Practical Skills					
Code	**Module Title**	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**C1**	**C2**	**C3**	**C4**	**C5**	**D1**
Compulsory modules																	
ELEC6201	Microfabrication	x	x	x	x		x		x	x		x	x	x			x
ELEC6203	Microsensor Technologies	x	x	x	x	x	x	x	x	x		x	x	x			x
ELEC6208	Bio/Micro/Nano Systems	x	x	x	x	x	x	x	x	x		x	x	x			x
ELEC6211	Project Preparation	x				x			x	x	x	x	x			x	
Core modules																	
COMP6200	MSc Project	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x
Semester 1 optional modules																	
ELEC3207	Nanoelectronic Devices	x		x	x	x	x	x	x			x	x				x
ELEC6202	Advanced Memory and Storage	x		x		x	x		x	x		x	x	x			x
ELEC6204	Microfluidics and Lab-on-a-Chip	x	x	x	x	x	x	x	x			x	x				x
ELEC6205	Bionanotechnology	x	x			x	x		x	x		x	x	x			x
OPTO6007	An Introduction to Silicon Photonics	x	x	x	x	x	x	x	x	x			x				x
Semester 2 optional modules																	
ELEC3202	Green Electronics	x		x	x	x	x	x	x			x	x	x			x
ELEC6206	Nanofabrication and Microscopy	x	x	x	x			x	x				x				x
ELEC6207	Quantum Devices and Technology	x		x	x	x	x		x	x		x	x	x			x
ELEC6227	Medical and Electrical Technologies	x		x		x				x		x	x				
OPTO6003	Photonic Materials	x	x	x	x	x	x	x				x	x				x

Code	Module Title	Assessment Methods	
		Coursework(s)	Exam
Semester 1 - compulsory modules			
ELEC6201	Microfabrication	Lab report - **30%**	2 hours - **70%**
ELEC6203	Microsensor Technologies	Lab report - **30%**	2 hours - **70%**
Semester 2 - compulsory modules			
ELEC6208	Bio/Micro/Nano Systems	Lab report accelerometer - **40%** Lab report nanoresonator - **30%** Lab report glucose sensor - **30%**	-
ELEC6211	Project Preparation	Literature review - **40%** Project plan - **30%** Poster - **30%**	-
Summer - core module			
COMP6200	MSc Project	Dissertation - **100%**	-
Semester 1 - optional modules			
ELEC3207	Nanoelectronic Devices	Simulation report - **30%**	2 hours - **70%**
ELEC6202	Advanced Memory and Storage	Literature review - **20%** Lab report - **30%**	2 hours - **50%**
ELEC6201	Microfabrication	Lab report - **30%**	2 hours - **70%**
ELEC6204	Microfluidics and Lab-on-a-Chip	Simulation report - **30%**	2 hours - **70%**
ELEC6205	Bionanotechnology	Lab report - **30%**	2 hours - **70%**
OPTO6007	An Introduction to Silicon Photonics	Work sheets x2 - **25%**	2 hours - **75%**
Semester 2 - optional modules			
ELEC3202	Green Electronics	Exercise (lab report) - **30%**	2 hours - **70%**
ELEC6206	Nanofabrication and Microscopy	Simulation report - **30%**	2 hours - **70%**
ELEC6207	Quantum Devices and Technology	Literature review - **20%** Lab report - **30%**	2 hours - **50%**
ELEC6227	Medical and Electrical Technologies	Literature review x3 - **100%**	-
OPTO6003	Photonic Materials	Assignment - **30%**	2.5 hours - **70%**

Appendix 2:

Additional Costs

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme typically also have to pay for the items listed in the table below.

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
Approved Calculators		Candidates may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University approved models are Casio FX-570 and Casio FX-85GT Plus. These may be purchased from any source and no longer need to carry the University logo.
Stationery		You will be expected to provide your own day-to-day stationary items, e.g. pens, pencils, notebooks, etc). Any specialist stationery items will be specified under the Additional Costs tab of the relevant module profile.
Textbooks		Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as **optional** background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.
Equipment and	Art Equipment and Materials: Drawing paper;	

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
Materials **Equipment**	painting materials; sketchbooks	
	Art Equipment and Materials: Fabric, Thread, Wool	
	Design equipment and materials:	
	Excavation equipment and materials:	
	Field Equipment and Materials:	
	Laboratory Equipment and Materials:	
	Medical Equipment and Materials: Fobwatch; stethoscopes;	
	Music Equipment and Materials	
	Photography:	
	Recording Equipment:	
IT	Computer Discs	
	Software Licenses	
	Hardware	
Clothing	Lab Coats	
	Protective Clothing: Hard hat; safety boots; hi-viz vest/jackets;	
	Fieldcourse clothing:	
	Wet Suits?	
	Uniforms?	
Printing and Photocopying Costs		In the majority of cases, coursework such as essays; projects; dissertations is likely to be submitted on line. However, there are some items where it is not possible to submit on line and students will be asked to provide a printed copy.

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
Fieldwork: logistical costs	Accommodation:	
	Insurance	
	Travel costs	
	Immunisation/vaccination costs	
	Other:	
Placements (including Study Abroad Programmes)	Accommodation	
	Insurance	
	Medical Insurance	
	Travel costs	
	Immunisation/vaccination costs	
	Disclosure and Barring Certificates or Clearance	
	Translation of birth certificates	
	Other	
Conference expenses	Accommodation	
	Travel	
Optional Visits (e.g. museums, galleries)		
Professional Exams		
Parking Costs		
Anything else not covered elsewhere		

Revision History

1. Specifications written by Dr Maurits de Planque, based on ECS MSc exemplars – 20/2/2017
2. Revision of educational aims and some learning outcomes, following validation meeting – 17/7/2017
3. FPC approval – 19/7/2017